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(54) Aerosol metering valve assembly

(57) A valve is provided for dispensing metered doses from an aerosol container (2) which contains a liquid. The valve comprises a metal cup (12) open at the upper end thereof and also having an opening (15) at its lower end, the cup (12) defining a cavity. First and second valve seals (16,17) are located at opposite ends of the cup. A metal valve stem (21) passes in sliding and sealing contact through an opening in the first valve seal (16) into the cavity. A metering chamber (32) is defined by the cup (12), the valve seals (16,17) and the portion of the valve stem (21) within the cavity. The valve stem is movable from a first position in which liquid can enter the metering chamber into a second position in which a dose of liquid is dispensed from the metering chamber, against the bias of a spring.

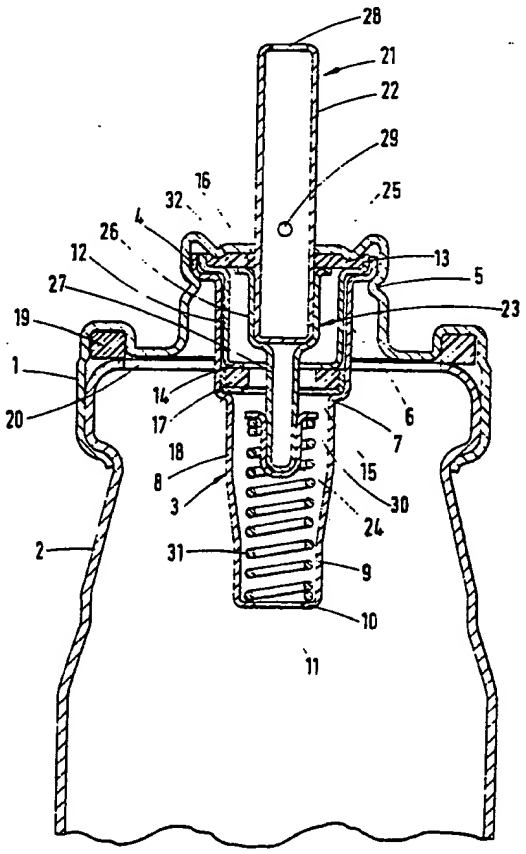

Fig.1

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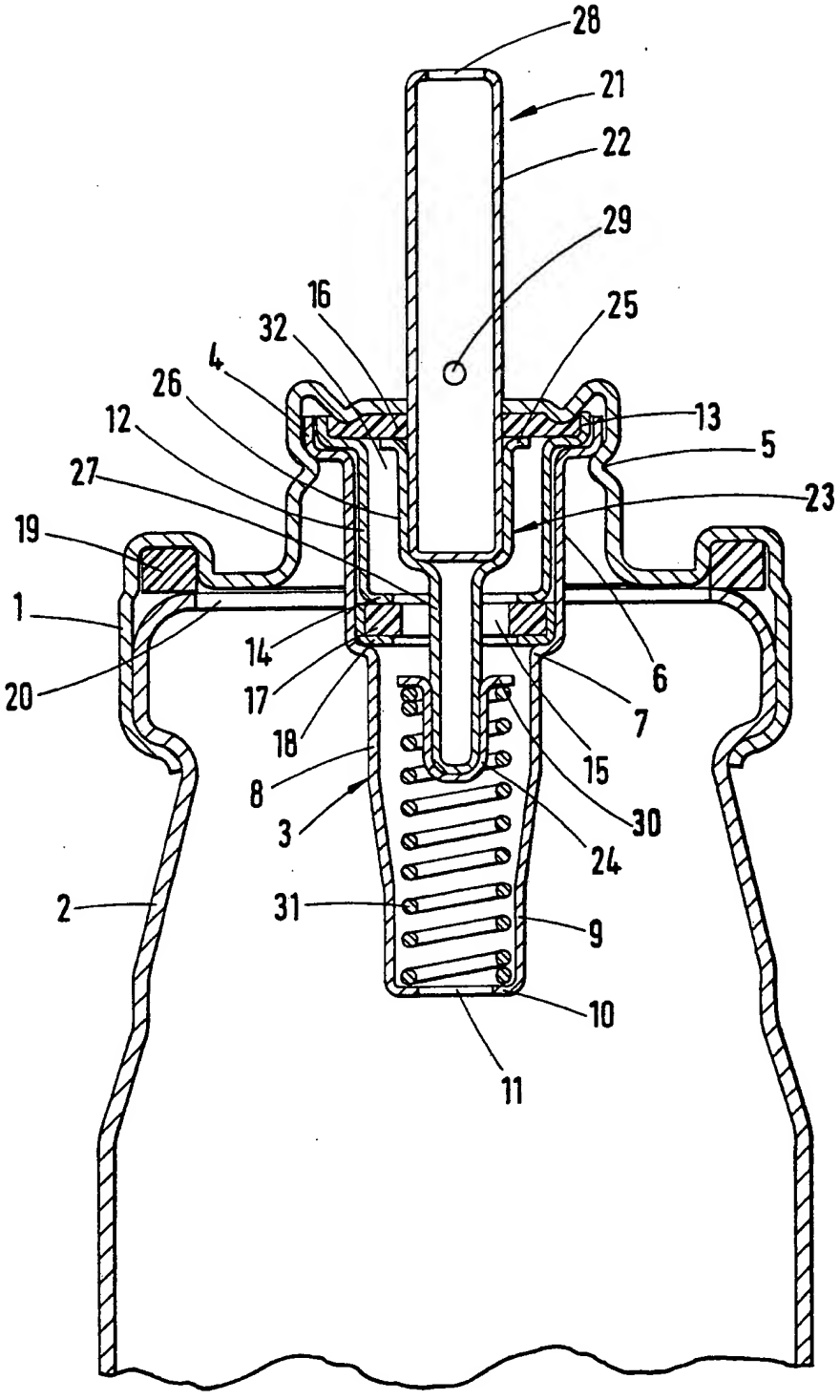
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Fig.1

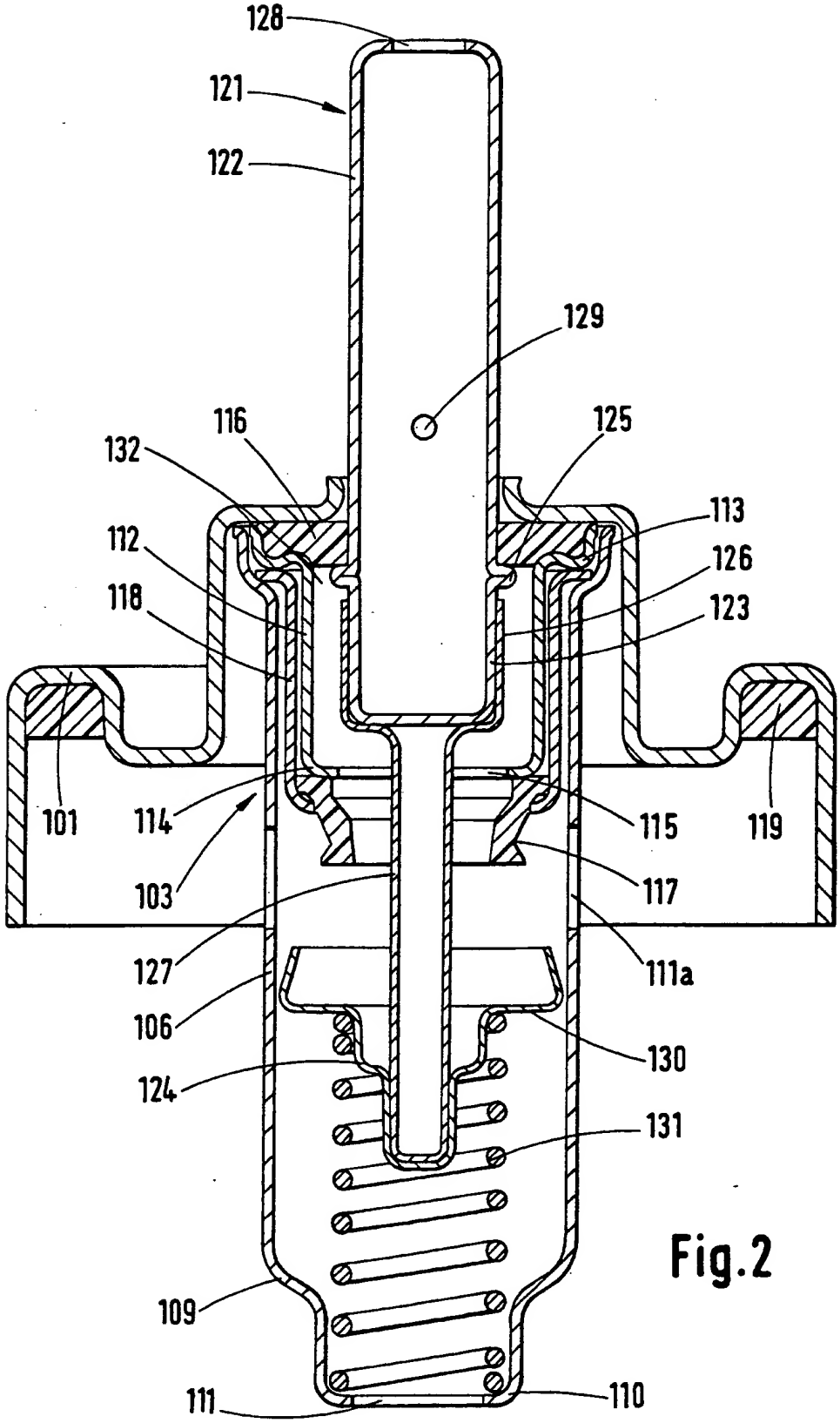
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Fig.2

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Valve Assembly

This invention relates to a valve assembly for an aerosol container, with the aid of which a metered dose of the contents of an aerosol container can be dispensed. The invention has particular application to the dispensing of medicaments, though it is applicable to the dispensing of aerosols generally.

In dispensing certain products, particularly medicaments, it is highly desirable that the dose dispensed on each occasion should be as near as possible to a predetermined value. With many known valves for aerosol containers there is a significant risk that on some occasions the requisite dose may not be dispensed, this can occur, for example, if the aerosol container has been vigorously shaken prior to dispensing. To deal with this problem GB2004526A describes valves of a type in which a metering chamber communicates with the interior of the aerosol container through an orifice of a size such that when the container is in an orientation with the valve uppermost the metering chamber rapidly and completely empties, and when the container is inverted so that the valve is at the bottom the metering chamber rapidly and completely fills. Although the valves described therein should, in principle, overcome the problem of the dispensing of variable doses, it has been found

that in practice, it is not possible economically to make valves of the described type which are satisfactory. The valves described are specifically intended to be made of plastics material, and it has been found that the tolerances must be so tightly controlled if the metering chamber is to be of the desired size that conventional moulding techniques cannot cope with the production requirements thus imposed. Furthermore, even if the valve were initially made with the required degree of precision it might not maintain that precision during the life of the valve, owing to creep. There is also a risk with plastics components that they may interact in some fashion with the contents of the container. This is particularly critical if one is dealing with the dispensing of a medicament. It is possible that either the propellant or the drug itself might interact with the plastics material, and if it did the consequences could be serious.

It has been known for many years to produce valves for aerosol containers from metal components. The use of a suitable metal, for example stainless steel, has considerable advantages over plastic in various respects. When formed by an appropriate technique, for example deep-drawing, a greater degree of precision can be obtained with a metal component, and the metal is much less liable to suffer from creep

than a corresponding plastics component. Furthermore, metals such as stainless steels have been used for many years in medical applications and their inertness is well proven in many situations. Accordingly, it can generally be said with confidence that such a metal will not interact with the contents of the container.

Despite the fact that metal valves for some types of aerosol container have been well known for many years it has not hitherto been realised that a valve embodying the principle of rapid filling/rapid emptying, such as is a feature of the valves described in GB2004526A, could be achieved using metal components. The present invention arises from the appreciation that such a metal valve can in fact be made.

According to the present invention there is provided a valve for dispensing metered doses from an aerosol container which contains a liquid, the valve comprising a metal cup open at the upper end thereof and also having an opening at the lower end thereof, the cup defining a cavity therein; first and second valve seals at opposite ends of the cup; a metal valve stem formed at least in part as a hollow tube and having an outlet through which a dose can be dispensed from the container and a transfer port extending from the exterior of the valve stem to the outlet passage thereof, the valve stem passing in sliding and sealing

contact through an opening in the first valve seal into the cavity, a metering chamber being defined by the said cup, the first and second valve seals and the portion of the valve stem within the cavity; and means for biasing the valve stem to a first position in which, with the container inverted so that the valve is at the bottom, liquid can enter the metering chamber through at least one orifice of a size sufficient to allow the liquid to enter rapidly, and with the container not inverted, liquid can leave the metering chamber rapidly through the at least one orifice, and being movable against the force of said biasing means into a second position in which the valve stem closes off the opening in the second valve seal to prevent further liquid entering the metering chamber and in which the transfer port is in communication with the metering chamber to permit liquid to pass from the metering chamber into the outlet of the valve stem.

Various preferred features will become apparent from the ensuing description of a preferred embodiment. This is shown in the accompanying drawings, in which:

Figure 1 is a vertical section through the upper portion of an aerosol container with a valve according to the invention mounted thereon; and

Figure 2 is a similar view of a second embodiment of valve, but not showing the container.

In the arrangement illustrated in Figure 1, the

metering valve is fitted in a ferrule or cap 1 of an aerosol container 2. The container contains a material to be dispensed suspended in a volatile liquid propellant. When the device is not being used the container may be placed with the valve uppermost. This is the position illustrated in the drawing. When the device is in use to dispense a dose of material the container is inverted from this position.

The valve comprises a valve body 3 which is in the form of a hollow metal tube having a diameter greater at the top than at the bottom. At the upper end the valve body 3 has a flange portion 4 by means of which the valve body 3 is held in position in the cap 1 by a crimp 5. A cylindrical portion 6 extends downwardly from the flange portion 4, and the portion 6 is connected via a step 7 with a further cylindrical portion 8. This in turn leads to a tapered portion 9 which terminates in an inwardly directed flange 10. An opening 11 is defined at the lower end of the valve body 3.

A metal cup 12 is received within the cylindrical portion 6 of the valve body 3. At its upper end the cup 12 has a flange portion 13 which sits on the flange portion 4 of the valve body. At its lower end the cup 12 has an inwardly directed flange 14 which defines an opening 15. An upper valve seal 16 is held between the upper portion of the cap 1 and the flange portion 13 of

the cup 12. A lower valve seal 17 is held between the flange portion 14 of the cup 12 and a metal washer 18 which rests on the step 7. There is also a seal 19 which helps to provide firm sealing engagement between the cap 1 and the container 2. It should be noted that the container is open at its upper end, having an opening 20.

A valve stem 21 has its lower end located within the valve body 3, the valve stem passing through an opening in the seal 16 and an opening in the top of the cap 1 so that its upper end is outside the container. The valve stem is formed of three metal components, namely an upper tube 22 an intermediate section 23 and a lower cup 24. The three components are press-fitted one on another. The tube 22 has an outlet opening 28 at its upper end and a transfer port 29 extending through the cylindrical wall thereof. The tube is closed at its lower end. The intermediate section 23 has a flange 25 at its upper end which, when the valve stem is in the position illustrated in the drawing, bears against the underside of the valve seal 16. The intermediate section 23 further comprises upper and lower cylindrical portions 26 and 27, the portion 26 being a press fit on the lower end of the tube 22 and the portion 27 being of lesser diameter than the portion 26. The lower end of the portion 27 is closed. The cup 24 is press-fitted on the portion 27 and has an

upper, outwardly extending flange 30. A compression spring 31 extends between the flanges 10 and 30 to bias the valve stem into the position shown in the drawings.

The valve body 3, the cup 12 and the three portions of which the valve stem is made can all be formed by deep-drawing. Preferably each of these components is made of stainless steel.

In use, the container is inverted and liquid flows through the opening 11, past the cup 24, through the opening 15 and thence into the metering chamber 32. To ensure that this flow can take place sufficiently rapidly the cross-section of the path along which the liquid has to travel to reach the metering chamber is so chosen that at no point is it less than a selected minimum value which depends on the viscosity of the liquid concerned. Typically the cross-section should not be less than about 6 or 7 mm^2, depending on the viscosity of the liquid. The user then depresses the valve stem 21 against the force of the spring 31. This brings the outer surface of the portion 26 of the intermediate section 23 of the valve stem into sealing contact with the radially inner surface of the lower valve seal 17, thus isolating the metering chamber 32 from the rest of the interior of the container. Continued depression of the valve stem brings the transfer port 29 into communication with the metering chamber, so that liquid can flow from the metering

chamber through the transfer port 29 into the interior of the tube 22 of the valve stem 21, and thence out through the outlet opening 28.

The embodiment shown in Figure 2 is similar in many respects to that shown in Figure 1. Parts in Figure 2 which correspond to parts in Figure 1 are denoted by the same reference numeral but with the addition of 100. Because of the similarities, the embodiments of Figure 2 will not be described in detail, but attention will be drawn to a number of differences.

The lower valve seal 17 of Figure 1 is replaced by a more elongate and therefore more flexible seal 117. The seal 117 is of generally cylindrical form with the upper and lower portions thereof being of greater thickness than an intermediate portion thereof. The construction of the seal 117 is less likely to cause the valve stem to become jammed in its operating position than is the construction of seal 17. The washer 18 of Figure 1, on which the valve seal 17 rests, is replaced by an outer cup 118 which surrounds the cup 112 forming the metering chamber and which is held at its upper end between the cup 112 and the valve body 103. This makes it possible to simplify the shape of the valve body by omitting the step 7. It should also be noted that in addition to an opening 111 in the lower end of the valve body there are side openings

111a.

The construction of the valve stem 121 differs from the valve stem 21 of Figure 1 in a number of respects. Firstly the intermediate section 123 does not have a flange at its upper end, and instead an annular bead 125 is formed on the outside of the upper tube 122 to bear against the upper valve seal 116. Secondly, the lower cup 124 has a stepped shape and the upper end thereof extends radially outward to a location adjacent the inner wall of the valve body 103. This provides a guide for the valve stem as it moves up and down to reduce the extent to which the valve stem can tilt, and to reduce the risk of damage to the valve or jamming.

CLAIMS

1. A valve for dispensing metered doses from an aerosol container which contains a liquid, the valve comprising a metal cup open at the upper end thereof and also having an opening at the lower end thereof, the cup defining a cavity therein; first and second valve seals at opposite ends of the cup; a metal valve stem formed at least in part as a hollow tube and having an outlet through which a dose can be dispensed from the container and a transfer port extending from the exterior of the valve stem to the outlet passage thereof, the valve stem passing in sliding and sealing contact through an opening in the first valve seal into the cavity, a metering chamber being defined by the said cup, the first and second valve seals and the portion of the valve stem within the cavity; and means for biasing the valve stem to a first position in which, with the container inverted so that the valve is at the bottom, liquid can enter the metering chamber through at least one orifice of a size sufficient to allow the liquid to enter rapidly, and, with the container not inverted, liquid can leave the metering chamber rapidly through the at least one orifice, and being movable against the force of said biasing means

into a second position in which the valve stem closes off the opening in the second valve seal to prevent further liquid entering or leaving the metering chamber and in which the transfer port is in communication with the metering chamber to permit liquid to pass from the metering chamber into the outlet of the valve stem.

2. A valve according to claim 1, wherein the valve stem comprises an upper section in the form of the said hollow tube, an intermediate section secured to the lower end of the upper section and of smaller cross-section over at least part of its length than the said opening in the second valve seal, and a lower section secured to the lower end of the intermediate section and providing a seat against which the said biasing means can bear.

3. A valve according to claim 2, wherein the said lower section of the valve stem forms a guide member to guide the valve stem in the course of its movement between said first and second positions.

4. A valve according to claim 2 or 3, wherein the upper end of the said intermediate section of the valve stem has a flange formed thereon which, when the valve stem is in said first position, bears against the underside of the upper valve seal to prevent further

upward movement of the valve stem.

5. A valve according to claim 2 or 3, wherein the said upper section has a protrusion formed on the exterior thereof which, when the valve stem is in said first position, bears against the underside of the upper valve seal to prevent further upward movement of the valve stem.

6. A valve according to any preceding claim, wherein the lower valve seal is retained between a lower end portion of the said cup and a retaining member mounted in a surrounding valve body.

7. A valve according to any one of claims 1 to 5, wherein the lower valve seal is retained between a lower end portion of the said cup and a lower end portion of a second cup which surrounds the first mentioned cup.

8. A valve according to any preceding claim, wherein the lower valve seal is of generally cylindrical form with the upper and lower portions thereof being of greater thickness than an intermediate portion thereof.

9. A valve according to any preceding claim, wherein the said at least one orifice is not less than 6 mm^2 in

cross-section.

10. A valve according to any one of claims 1 to 8, wherein the said at least one orifice is not less than $7mm^2$ in cross-section.

11. A valve for dispensing metered doses from an aerosol container, substantially as herein described with reference to Figure 1 or Figure 2 of the accompanying drawings.

12. An aerosol container having mounted therein a valve according to any preceding claim.

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